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Indian Standard

METHOD FOR
DETERMINATION OF MASS OF ALUMINIUM
COATING ON HOT-DIP ALUMINIZED
IRON OR STEEL ARTICLES

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

Indian Standard

METHOD FOR DETERMINATION OF MASS OF ALUMINIUM COATING ON HOT-DIP ALUMINIZED IRON OR STEEL ARTICLES

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Indian Standard

METHOD FOR DETERMINATION OF MASS OF ALUMINIUM COATING ON HOT-DIP ALUMINIZED IRON OR STEEL ARTICLES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 15 March 1973, after the draft finalized by the Hot-Dip Metallic Coatings Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 The mass for unit area of coating of hot-dip aluminized iron and steel articles is determined by stripping the coating with suitable reagents. This standard describes the details of this method as well as the preparation of test pieces to be taken from the aluminized iron and steel articles for this purpose. The direct method of determination of mass of aluminium coating by weighing the article before and after hot-dip aluminizing and subtracting the first mass from second and dividing the result by surface area has not been included as it gives slightly lower results.

0.3 The test methods have been based on the procedures generally followed in the country in this field. Assistance has also been derived from ASTM Part 3 1970 'Steel sheet, strip, bar, rod, wire, metallic coated products', issued by American Society for Testing and Materials.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the procedures for determination of mass of aluminium coating of aluminized iron and steel articles.

*Rules for rounding off numerical values (*revised*).

2. QUALITY OF REAGENTS

2.1 Unless otherwise specified, pure chemicals shall be employed in tests and distilled water (*see* IS : 1070-1960*) shall be used when the use of water as a reagent is intended.

NOTE — ' Pure chemicals ' shall mean chemicals that do not contain impurities which affect the results of analysis.

3. SAMPLING

3.0 Sampling of the material shall be done in accordance with the relevant material specification. This clause relates only to the preparation of test pieces from the samples thus taken.

3.1 Hot-Dip Aluminized Sheet

3.1.1 Test piece shall be taken by one of the following methods subject to purchaser's requirements:

- a) *Triple Spot Test* — Three test pieces either square of 50 mm side or circular of 50 mm diameter shall be taken, one from the centre and two from the opposite ends of the diagonal line, at least 100 mm away from the top or the bottom and at least 50 mm away from the side. For sheets aluminized by the continuous method, three test pieces shall be taken at the end part of the coil, one from the centre and two from the location at least 50 mm away from each side.
- b) *Single Spot Test* — In this test, one test piece out of the three test pieces taken by the same method as for the triple spot test showing a minimum coating mass shall be selected, or the test piece shall be taken out of any place within at least 100 mm away from the top or the bottom and at least 50 mm away from the side.

3.1.2 When it is not possible to obtain a test piece of measurable area as is described in 3.1.1, such as from corrugated sheet, the formula given in 5.2.1.5 may be used to calculate the mass of coating.

3.2 Hot-Dip Aluminized Wire — Test piece of wire to be stripped may be of any length over 300 mm preferably 600 mm. It is not necessary to measure the length. The test piece may be cut into convenient lengths (about 150 mm) for weighing on a chemical balance, and several pieces weighed and stripped as one test piece.

3.3 Hot-Dip Aluminized Articles Other Than Sheet and Wire — Sampling for articles other than sheet and wire may be carried out as agreed to between the supplier and the purchaser.

*Specification for water, distilled quality (*revised*).

4. CLEANING OF TEST PIECE

4.1 The test pieces shall be washed with solvent naphtha, trichloro ethylene or any other suitable organic solvent, then with alcohol; and finally dried thoroughly.

5. STRIPPING METHOD

5.1 Reagents

5.1.1 *Sodium Hydroxide Solution* — 20 percent (m/v).

5.1.2 *Concentrated Hydrochloric Acid* — sp gr 1.16 (conforming to IS : 265-1962*).

5.2 Procedure

5.2.1 *Aluminized Sheet*

5.2.1.1 Weigh the test pieces, obtained in accordance with 3, to the nearest 0.005 g. For the triple spot test, the three test pieces may be weighed together or individually depending on whether an average or minimum value of the mass of coating is desired. Heat the sodium hydroxide solution to approximately 90°C (see Note) and immerse each test piece in hot solution until the reaction ceases. In case of silicon-free coatings, hydrogen gas may be evolved for considerable time but the test piece should not be left in the solution for more than a few minutes. Longer immersion inhibits the removal of coating during subsequent dips. Several test pieces may be immersed simultaneously provided all surfaces are freely exposed to the solution.

NOTE — This temperature is not critical but the solution should be held several degrees below the boiling point (approximately 105°C) to prevent excessive foaming during the first immersion. The beaker used for heating the solution and immersing the test pieces should be less than half filled with solution to avoid the danger of foaming when the test pieces are immersed.

5.2.1.2 Remove the test pieces from solution and scrub all the surfaces under running water with a clean sponge to remove the loose deposits formed in the sodium hydroxide solution. Vigorous scrubbing may be necessary for some types of coatings, but abrasive materials should not be used to remove the deposits. Blot with a towel to remove most of the water (see Note 1) and immerse each test piece individually for not more than 3 seconds in concentrated hydrochloric acid at room temperature. Remove, scrub again under water with a sponge, and reimmerse in hot sodium hydroxide solution for not more than a few minutes or until reaction again ceases. Repeat this cycle until immersion

*Specification for hydrochloric acid (revised).

in hydrochloric acid shows no visible reaction (see Note 2). One to three or more cycles may be required, depending on the type of coating.

NOTE 1 — Most of the water should be removed to prevent dilution of the hydrochloric acid as dilute hydrochloric acid attacks the base metal to a greater extent than concentrated hydrochloric acid.

NOTE 2 — It is sometimes difficult to determine the point at which all of the alloy layer has been removed, when stripping silicon-free coatings. If in doubt, weigh the test piece (after scrubbing and drying) and then put it through one additional stripping cycle.

5.2.1.3 After the final immersion in sodium hydroxide and hydrochloric acid solutions, scrub as before, dry thoroughly, and reweigh to the nearest 0.005 g.

5.2.1.4 Report the weight of coating in g/m² to two decimal places where it is not possible to determine the area, calculate the weight by using formula given under **5.2.1.5**.

5.2.1.5 Calculation

$$M = \frac{M_1 - M_2}{M_2} \times t \times 7\,860$$

where

M = mass of aluminium coating in g/m² of sheet,

M_1 = mass in g of aluminium coated test piece,

M_2 = mass in g of stripped test piece, and

t = thickness of stripped sheet in mm.

5.2.2 Aluminized Wire

5.2.2.1 Weigh the test piece, obtained in accordance with **3.2**, to the nearest 0.005 g. Three test pieces may be weighed together or individually depending on whether an average or minimum value of the weight of coating is desired. Further carry out the procedure given in **5.2.1.1** and **5.2.1.2**.

5.2.2.2 After the final immersion in sodium hydroxide solution and concentrated hydrochloric acid, scrub as before, dry thoroughly, and reweigh to the nearest 0.005 g. Determine the diameter of the wire after stripping by taking an average of the two measurements made at right angles to each other.

5.2.2.3 Calculation

$$\text{Mass of coating g/m}^2 = \frac{M_1 - M_2}{M_2} \times D \times 1\,965$$

where

M_1 = original mass in g of the test piece,

M_2 = mass in g of the stripped test piece, and

D = diameter of stripped test piece in mm.

5.2.3 Articles Other Than Sheet and Wire

5.2.3.1 Weigh the cleaned test pieces and immerse them in sodium hydroxide solution as described in 5.2.1.1. Further carry out the procedure as given in 5.2.1.2. After final immersion in sodium hydroxide solution, scrub as before, dry thoroughly and reweigh to 0.005 g.

5.2.3.2 For test piece of uniform thickness of base metal, such as a piece of plate or pipe, determine the average thickness of the test piece and calculate the mass of aluminium coating as in 5.3.

5.3 Calculation

$$M = \frac{M_1 - M_2}{M_2} \times t \times 3\,930$$

where

M = mass of aluminium coating in g/m² of surface,

M_1 = original mass in g of test piece,

M_2 = mass in g of stripped test piece, and

t = thickness of the stripped test piece in mm.

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